WHAT IS CLAIMED IS:

1. A method of measuring a dose of ionizing radiation comprising the following steps:

(a) exposing a luminescent material to ionizing radiation to form an irradiated luminescent material;

(b) exposing said irradiated luminescent material to a light source to form an excited luminescent material;

(c) detecting fluorescent light emitted by said excited luminescent material to thereby determine the amount of fluorescent light emission induced by step (a); and

(d) determining said dose of ionizing radiation from the amount of fluorescent light detected in step (c) using calibration data, wherein said luminescent material comprises: a base material comprising Al_2O_3, a first dopant comprising Mg, and a second dopant comprising C and wherein said luminescent material has at least one type of aggregate oxygen vacancy defect.

2. The method of claim 1, wherein said calibration data is obtained by exposing said luminescent material to said ionizing radiation in a standard radiation field for a known period of time and detecting the amount of fluorescent light emitted after exposing said luminescent material to said light source.

3. The method of claim 1, wherein steps (b) and (c) are conducted simultaneously.

4. The method of claim 1, wherein said fluorescent light has a wavelength in the range between 650 and 900 nm and has a peak of emission band around 750 nm.

5. The method of claim 4, wherein said light source has a wavelength in the range between 300 to 370 nm.

6. The method of claim 4, wherein said light source has a wavelength of 335 nm.

7. The method of claim 4, wherein said light source has a wavelength in the range between 550 to 700 nm.

8. The method of claim 4, wherein said light source has a wavelength of 635 nm.

9. The method of claim 1, wherein said at least one oxygen vacancy defect comprises at least one color center having absorption bands in the region of 335±5 nm and 620±10 nm, an emission in the region of 750±5 nm and a 75±10 ns fluorescence lifetime.

10. The method of claim 1, wherein said fluorescent light has a wavelength in the range between 450 and 600 nm and centered at 520±10 nm.

11. The method of claim 10, wherein said light source has a wavelength in the range between 370 to 490 nm.

12. The method of claim 10, wherein said light source has a wavelength around 435 nm.

13. The method of claim 1, wherein said at least one oxygen vacancy defect comprises at least one color center having an absorption in the region of 435±5 nm, an emission in the region of 520±5 nm and a 9±3 ns fluorescence lifetime.

14. The method of claim 1, wherein said ionizing radiation comprises at least one member of the group consisting of: x-rays photons, gamma photons, beta particles, alpha particles or protons.

15. The method of claim 1, wherein, said luminescent material is essentially insensitive to room light before and after exposure to said ionizing radiation.

16. The method of claim 1, wherein said luminescent material includes a plurality of said aggregate oxygen vacancy defects in which is stored dosimetric information and said dosimetric information is essentially insensitive to heating up to at least 600°C.

17. A method of erasing dosimetric information comprising the following steps:

(a) providing an irradiated luminescent material including color centers induced by radiation; and

(b) illuminating said irradiated luminescent material with light having sufficient intensity to perform a two-photon absorption and ionization of said color centers induced by radiation, wherein said luminescent material comprises: a base material comprising Al_2O_3, a first dopant comprising Mg, a second dopant comprising C, and wherein said luminescent material has at least one type of aggregate oxygen vacancy defect.

18. The method of claim 17, wherein said light has a wavelength in the range between 290 and 380 nm.

19. The method of claim 17, wherein said light has a wavelength around 335 nm.

20. The method of claim 17, wherein said light has a wavelength in the range between 550 and 700 nm.

21. The method of claim 17, wherein said light has a wavelength around 635 nm.

22. A method of erasing dosimetric information comprising the following steps:

(a) providing an irradiated luminescent material including color centers induced by radiation; and

(b) annealing said irradiated luminescent material at 680±50°C for at least 1 minute to empty deep traps filled during irradiation, wherein said luminescent material comprises: a base material comprising Al_2O_3, a first dopant comprising Mg, a second dopant comprising C and wherein said luminescent material has at least one type of aggregate oxygen vacancy defect.

23. A method of obtaining radiation field image comprising the following steps:

(a) exposing at least one imaging plate in a radiation field to form at least one irradiated imaging plate;

(b) exposing said irradiated imaging plate to a light source to form a light exposed imaging plate; and

(c) measuring spatial distribution of fluorescent light produced by said imaging plate to obtain said radiation field image, wherein said imaging plate is comprised of a luminescent material, said luminescent material comprising: a base material comprising Al_2O_3, a first

dopant comprising Mg, and a second dopant comprising C and wherein said luminescent materials has at least one type of aggregate oxygen vacancy defect.

24. The method of claim 23, wherein said at least one imaging plate comprises a plurality of imaging plates.

25. The method of claim 23, wherein said light source performs scanning of a surface of said imaging plate

26. The method of claim 23, wherein said light source illuminates the surface of said imaging plate substantially uniformly.

27. The method of claim 23, wherein light from said light source has a wavelength in the region of 635 nm, and said fluorescent light has a wavelength in the region of 750 nm and a fluorescence lifetime of 75±10 ns.

28. The method of claim 23, wherein light from said light source has a wavelength in the region of 435 nm, and said fluorescent light has a wavelength in the region of 520 nm and a fluorescence lifetime of 9±3 ns.